

Please delete the first paragraph on page 3, lines 1-9, and replace it with the following:

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FR 2320974 A discloses a coating for a steel reinforcement element of a first layer of an organosilane and a second layer of an organic RFL adhesive, i.e. an aqueous emulsion of a resorcinol-formaldehyde resin and a rubber-containing latex, which is cured thereafter. This product can be used as a reinforcement element for rubber products. The curing of the RFL adhesive makes it impossible to get a smooth boundary layer between the coating and the rubber. Moreover the non-reactive rubber-latex is only held mechanically within the structure of the cross-linked resin and cannot contribute to the bonding between the coating layer and the rubber to be reinforced.

Please delete the two paragraphs on page 4, lines 9-21, and replace them with the following:

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The adhesion promotor is advantageously utilized in a method for coating a metal surface with an adhesion promotor, comprising the preparation of a solution of the adhesion promotor and the dipping or painting of said metal surface with said solution, wherein the adhesion promotor is an organosiloxane of the general formula (I) given below, wherein X is a siloxane group, a chlorosilane group or a bromosilane group, and especially: -SH; -SiHCl₂; -SiH₂Cl; -Si(Cl)₃; -SiHBr₂; -SiH₂Br; -SiBr₃; -Si(R'(Cl)₂); -Si(OR')₃; -Si(R'(OR')₂); COOH; COCl.

The adhesion promotor is pretreated before use in the following manner: a definite amount of water is added under stirring at elevated temperature, the amount being calculated to at least partially hydrolyse and to partially condense the siloxane. The solution is diluted with alcohol and immediately after a certain ripening period applied to said metal surface, thereby forming a dense mono- or multimolecular layer on the metal surface.

Please delete the paragraph on page 5, lines 4-8, and replace it with the following:

HP
The metal surface can be treated to clean and/or at least partially oxidize the surface. Preferably the metal surface is treated with isopropanol (iPrOH), a mixture of isopropanol with water (iPrOH-H₂O), or diluted aqueous HCl. It is also possible to treat the surface with KOH or with a carbonate. All these measures can be used alone or in combination with each other.

Please delete the paragraph on page 7, lines 23-27, and replace it with the following:

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The tensile strength of the steel wires or steel filaments ranges from 1500 MPa (1500 N/mm²) to over 4000 MPa and is mainly dependent upon the final diameter, the exact composition (amount of carbon + amount of micro-alloying components) and on the amount of final drawing reduction. These parameters can be tuned by the skilled practitioner in the field.

Please delete the paragraph on page 8, lines 4-13, and replace it with the following:

AG
Possible matrix polymers or polymeric backbones may be, for example, thermoplastics, thermoplastic elastomers, and elastomers. Furthermore, the polymer can be, for example, a common thermoplastic polymer such as a thermoplastic polyolefin, olefinic rubber, polyurethane or blends thereof, an elastomeric polymer or copolymer or an at least partially elastomeric block copolymer, such as styrene butadiene rubber, butyl rubber, acrylonitrile butadiene rubber, ethylene propylene diene copolymer, ethylene propylene copolymer, natural rubber, synthetic poly(isoprene) and chloroprene rubber. Moreover common prepolymers can be used

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that are compatible with and can be co-polymerized or crosslinked with the polymer to be reinforced.

Please delete the paragraph that begins on page 8, line 18, and ends on page 9, line 2, and replace it with the following:

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The functionalities (X) of the functionalized polymer composition, if bound directly to the metal surface, include thiol groups, mercapto groups, silanes, mono-, di- or tri- alkoxysilanes, the alkyl being methyl, ethyl, propyl, especially:

-SH; -SiHCl₂; -SiH₂Cl; -Si(Cl)₃; -SiHBr₂; -SiH₂Br; -SiBr₃;

-Si(R'(Cl)₂); -Si(OR')₃; -Si(R'(OR')₂); -COOH; -COCl; -PO₃H₂; -SO₂H, their acid anhydride and their acid chloride groups;

an organometallic group of the formula -M(OR')_n or -M(Cl)_n, whereby M is a metal selected from the group comprising Al, Sn, B, Ti and V, n being the ligand number corresponding to the metal M;

a phthalocyanine or a phthalonitrile group;

a monothiol or a monothiolate group;

and R' being alkyl, namely methyl, ethyl or propyl (branched or unbranched).

Please delete the paragraph on page 10, lines 12-16, and replace it with the following:

A8

It is important to recognize that there may be a choice as to which partner carries which functional group, the functionalized polymer of the coating or the additional adhesion promotor. The list of possible combinations between X and Y groups includes: amine-epoxy, epoxy-silane, epoxy-acidic moieties, chlorides, and others.

Please delete the paragraph that begins on page 10, line 17, and ends on page 11, line 18, and replace it with the following:

The adhesion promotor optionally used for a better corrosion protection is a bifunctional compound of the general formula (I)



with

X: -SH; -SiHCl₂; -SiH₂Cl; -Si(Cl)₃; -SiHBr₂; -SiH₂Br; -SiBr₃; -Si(R'(Cl)₂); -Si(OR')₃; -Si(R'(OR')₂); -COOH; -COCl; -PO₃H₂; -SO₂H, their acid anhydride and their acid chloride groups;

an organometallic group of the formula -M(OR')_n or -M(Cl)_n, whereby M is a metal selected from the group comprising Al, Sn, B, Ti and V, n being the ligand number corresponding to the metal M;

a phthalocyanin or a phthalonitril group;

a monothiol or a monothiolate group;

and R' being alkyl, namely methyl, ethyl or propyl (branched or unbranched);

R: -CH₂-; a -(CH₂)- chain, whereby 2 ≤ n ≤ 20 and whereby said chain may be unhalogenated, partially halogenated or perhalogenated and may contain aromatic or thiophen units, and whereby the chain and/or the units may comprise substituents selected from the group comprising:

-(CH₂)_iCH₃ with 0 ≤ i ≤ 5, -O(CH₂)_jCH₃, or -O(CF₂)_jCH₃ with 0 ≤ j ≤ 4, -CN and -NH₂; -CF₂-; -CH₂-CO-NH-CH₂-; CF₂-CO-NH-CF₂-; CH₂-CO-NH-CF₂-; CF₂-CO-NH-CH₂- and 0 ≤ n, m ≤ 16;

Y: NH₂, NHR', or NR'₂, or an unsaturated residue, especially an unsaturated terminal double or triple carbon-carbon bond; an acrylic or methacrylic acid group and its methyl or ethyl esters;

-CN; an activated carboxylic ester; an aldehyde group; an epoxide group;

-SH; -SiHCl₂; -SiH₂Cl; -Si(Cl)₃; -SiHBr₂; -SiH₂Br; -SiBr₃;

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Cont

-Si(R'(Cl)₂); -Si(OR')₃; -Si(R'(OR')₂); -COOH; -COCl; or a functional group capable of forming a complex with at least one ingredient of the non-metallic medium.

Ar: an aromatic and/or heteroaromatic system, optionally substituted, for example according to the above cited list of substituents.

Please delete the paragraph on page 12, lines 14-18, and replace it with the following:

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The metal surface can be treated to clean and/or at least partially oxidize the surface. Preferably the metal surface is treated with isopropanol (iPrOH), a mixture of isopropanol with water (iPrOH-H₂O), or diluted aqueous HCl. It is also possible to treat the surface with KOH or with a carbonate. All these measures can be used alone or in combination with one another.

Please delete the paragraph on page 12, lines 26-29, and replace it with the following:

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Surprisingly, it is possible to achieve good results from the deposition in a one step procedure. For this purpose, a mixture of the two materials as cited above or a solution of both—the polymer of the coating and the separate bifunctional adhesion promotor—is applied to the surface.

Please delete the paragraph on page 15, lines 28-30, and replace it with the following:

Steel cord

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A steel cord coated by an electrolytically deposited Zn layer is used in this example.

Please delete the paragraph on page 16, lines 11-13, and replace it with the following:

A13

The deposition of the polymer cation (material 'B') can be accomplished in one step together with an adhesion promoter (material "A").

Please delete the paragraph on page 16, lines 21-29, and replace it with the following:

A14

A first 10 cm³ aqueous solution of isopropanol, iPrOH-H₂O was realized, with iPrOH-H₂O proportions of 9:1. APS was added to this solution at 1% volume content. Material "B" was added to this solution. In this example, surface-modified polybutadiene was used, which is a powder of some 250 µm size particles. This product is derived by pulverizing commercial tires, and contains varying amounts of polybutadiene-costyrene, polybutadiene, natural rubber, carbon black, petroleum oil, zinc oxides and other additives. 400 mg of this powder is added to the preceding solution of "A". The resulting mixture is a heterogeneous suspension, and is stirred.

Please delete the paragraph on page 18, lines 1-19, and replace it with the following:

1.) Adhesion to natural rubber:

The composition of the rubber is: natural rubber: 100 parts, carbon black N300: 60 parts per hundred rubber (phr), oil: 11 phr, zinc oxide: 5 phr, stearic acid: 1 phr, 6-ppd: 1 phr, sulphur: 2.5 phr, MBS: 0.6 phr.

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Adhesion is quantified by the pull out force as per ASTM D2229. The embedded length is 25 mm. The vulcanization temperature was 150°C and vulcanization time was 20 minutes. The pull out speed is 100 mm/min, and the circle of the pull out clamp is 12.7 mm. Prior art stands for untreated zinc coated steel cord.